FIG. 1
PRIOR ART

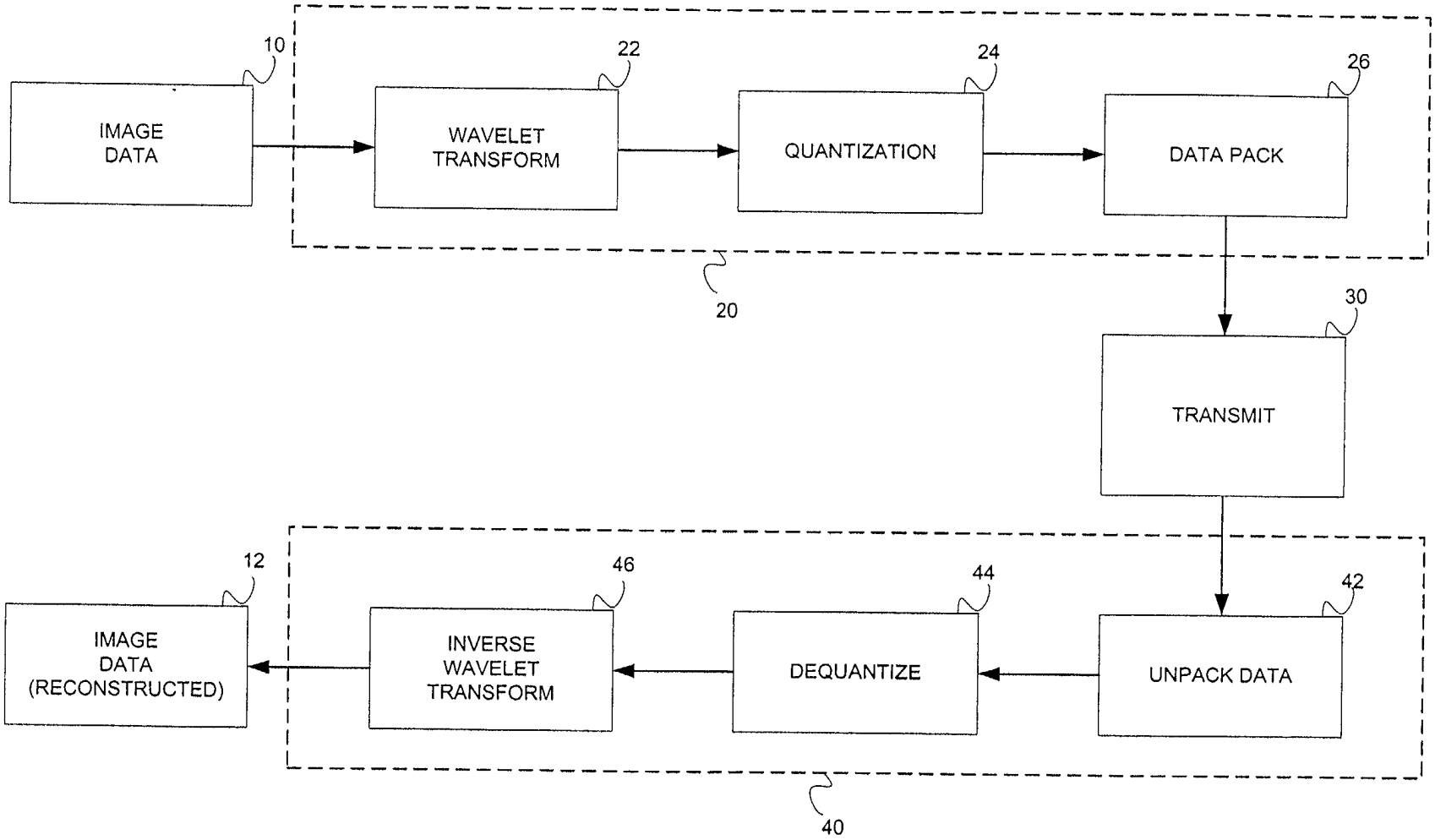


FIG. 2

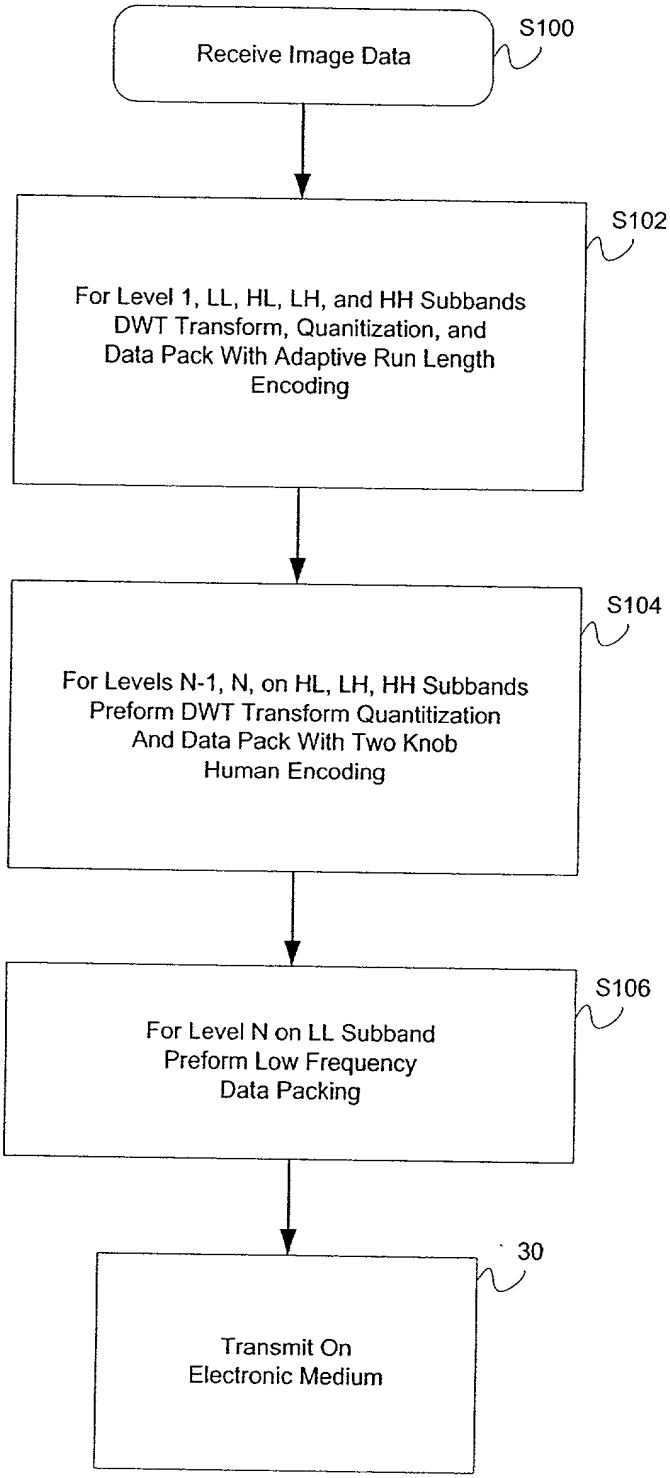

Receive Image Data
S100
For Level 1, LL, HL, LH, and HH Subbands DWT Transform, Quanitization, and Data Pack With Adaptive Run Length Encoding
S102
For Levels N-1, N, on HL, LH, HH Subbands Preform DWT Transform Quantitization And Data Pack With Two Knob Human Encoding
S104
For Level N on LL Subband Preform Low Frequency Data Packing
S106
Transmit On Electronic Medium
30

FIG. 3

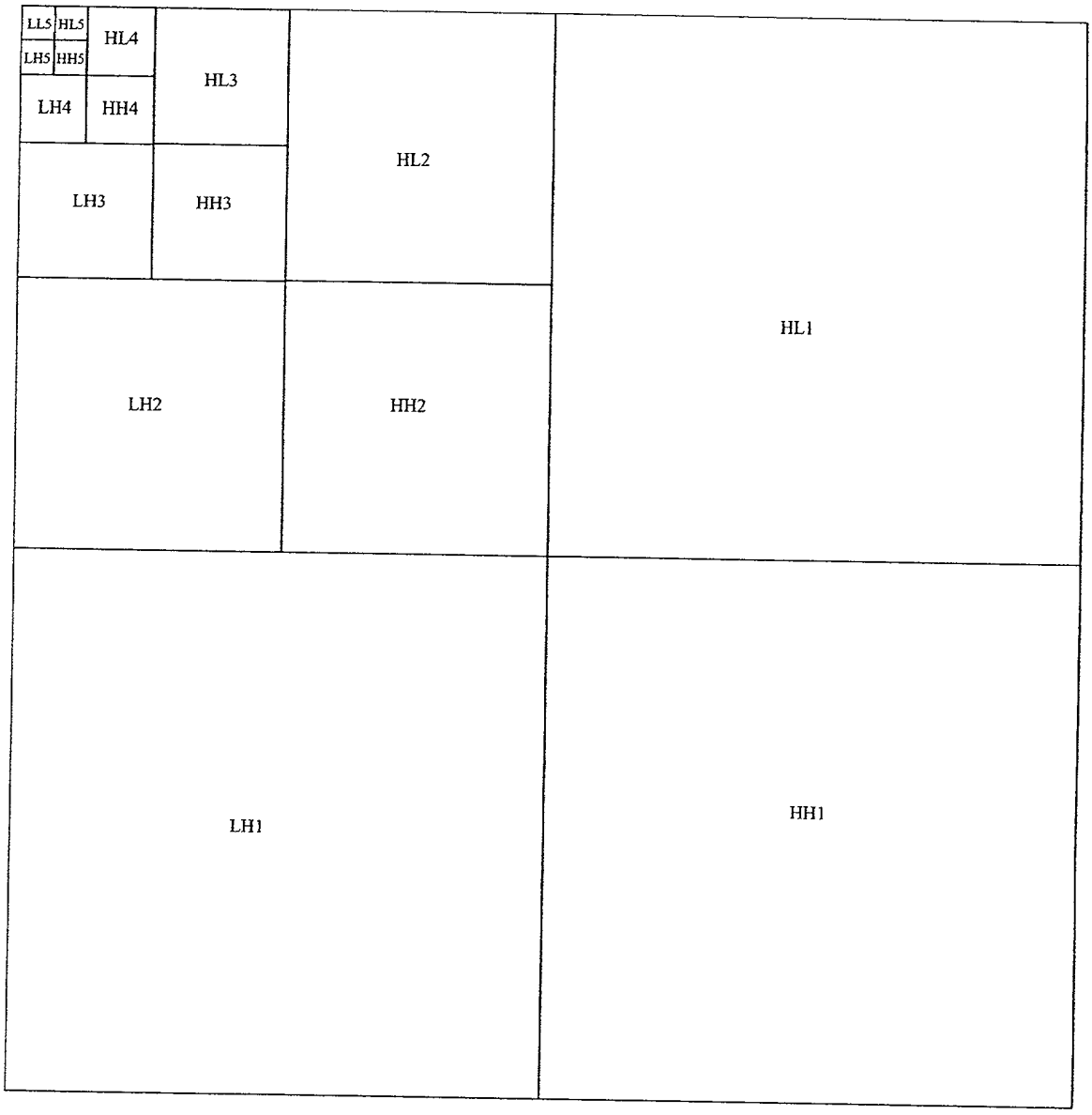


FIG. 4

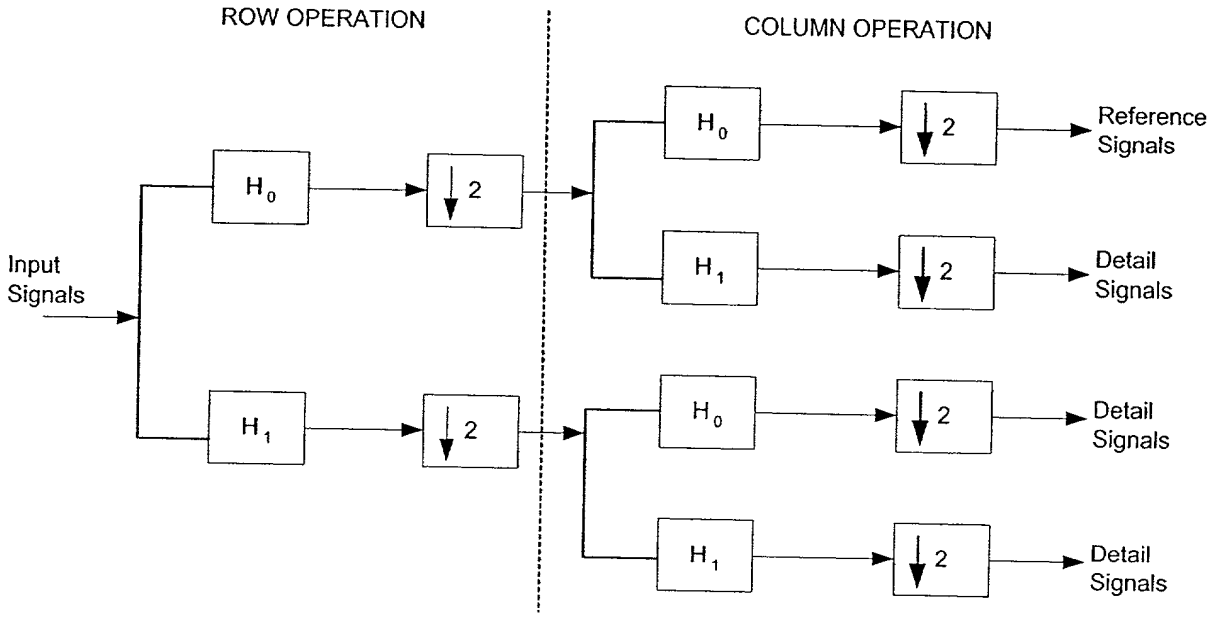

ROW OPERATION
COLUMN OPERATION
Input Signals
H0
H1
2
Reference Signals
Detail Signals
Detail Signals
Detail Signals

FIG. 5

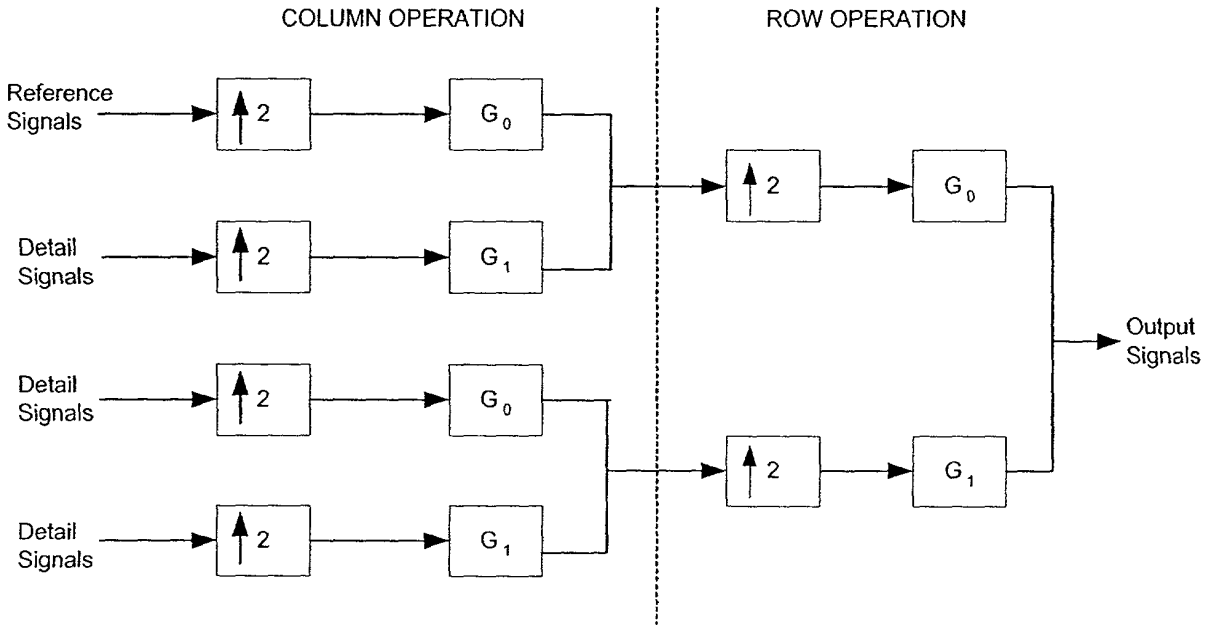

COLUMN OPERATION
ROW OPERATION
Reference Signals
Detail Signals
Detail Signals
Detail Signals
2
2
2
2
G_0
G_1
G_0
G_1
2
2
G_0
G_1
Output Signals

FIG. 6

```
Q=fix(abs(W)./cr).*sign(W)

W'=(abs(Q)+0.5).*cr.*(sign(Q))
```

Q:	Quantized coefficient
W:	Original wavelet coefficient
CR:	User defined compression parameter
W':	De-quantized coefficient
Fix:	Truncates value
Abs:	returns magnitude of value
Sign:	Return the sign of the number, Returns zero if the value is zero

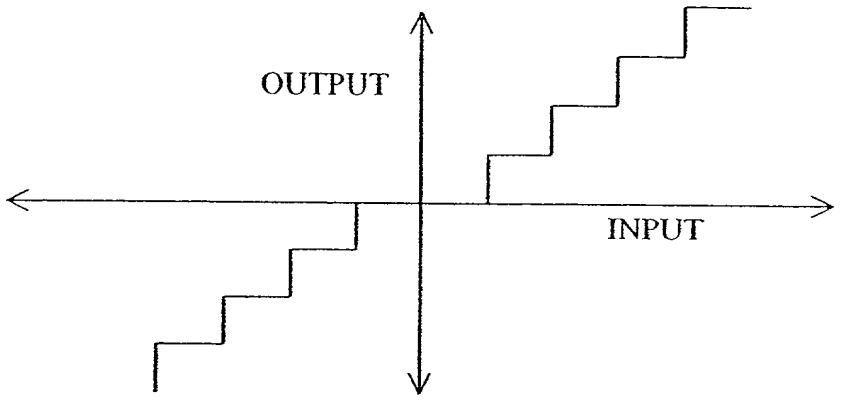


FIG. 7

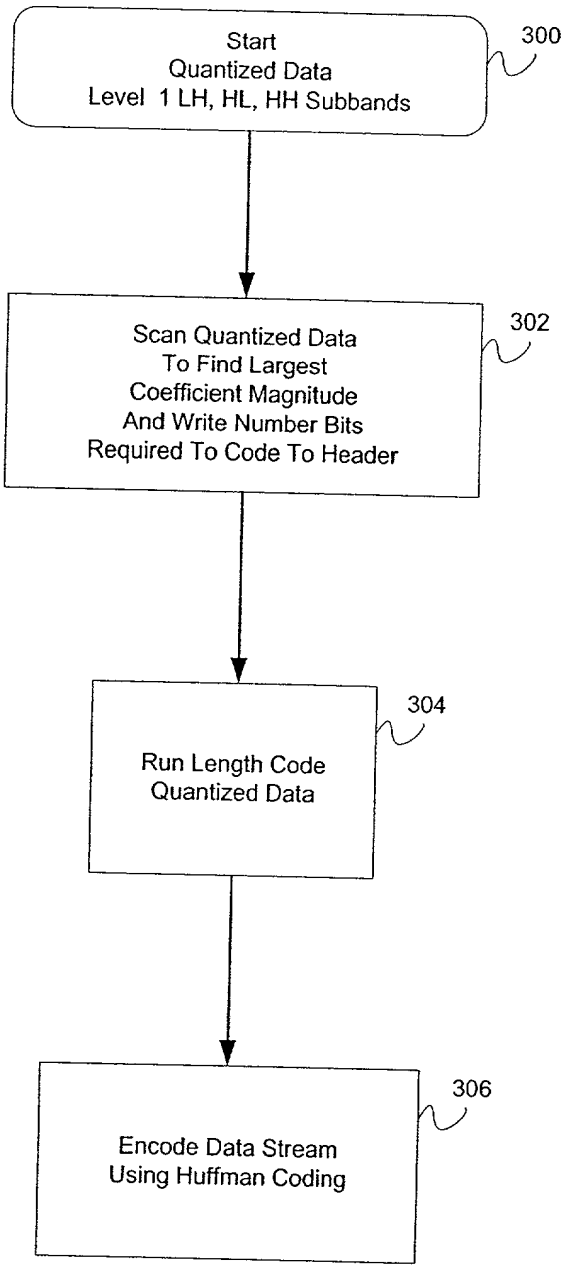

Start
Quantized Data
Level 1 LH, HL, HH Subbands
300
Scan Quantized Data
To Find Largest
Coefficient Magnitude
And Write Number Bits
Required To Code To Header
302
Run Length Code
Quantized Data
304
Encode Data Stream
Using Huffman Coding
306

FIG. 8

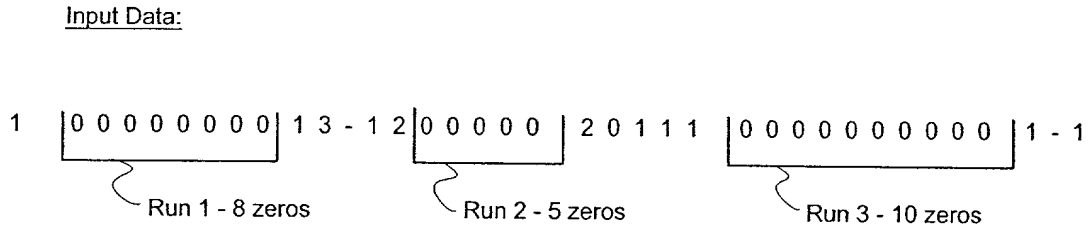

Input Data:
1 0 0 0 0 0 0 0 0 1 3 - 1 2 0 0 0 0 0 2 0 1 1 1 0 0 0 0 0 0 0 0 0 0 1 - 1
Run 1 - 8 zeros
Run 2 - 5 zeros
Run 3 - 10 zeros

FIG. 9A

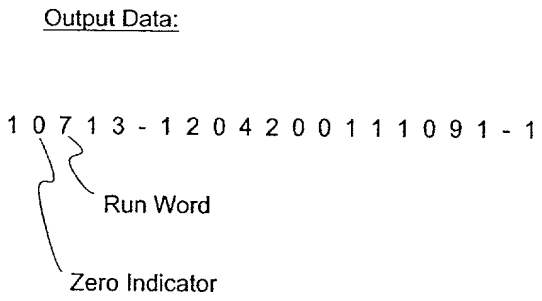

Output Data:
1 0 7 1 3 - 1 2 0 4 2 0 0 1 1 1 0 9 1 - 1
Run Word
Zero Indicator

FIG. 9B

Value	Code word
0	0
1	100
-1	101
2	1100
-2	1101
3	11100
-3	11101
4	1111000
-4	1111001
5	11110100
-5	11110101
6	11110110
-6	11110111
7	11111000
-7	11111001
8	111110100
-8	111110101
9	111110110
-9	111110111
10	111111000
-10	111111001
11	111111010
-11	111111011
12	1111111000
-12	1111111001
13	1111111010
-13	1111111011
14	1111111100
-14	1111111101
15	1111111110
esc	1111111111

FIG. 10

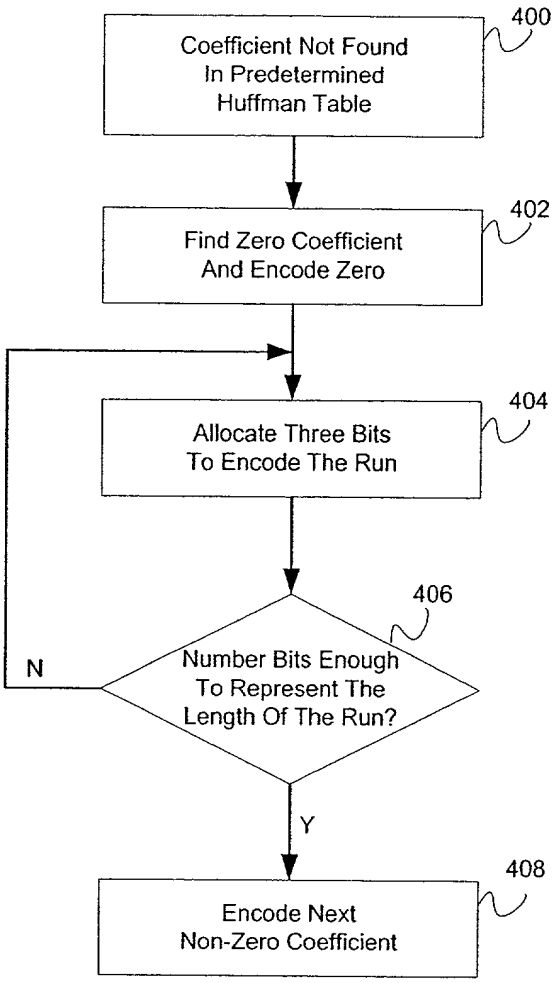

Coefficient Not Found In Predetermined Huffman Table
400
Find Zero Coefficient And Encode Zero
402
Allocate Three Bits To Encode The Run
404
Number Bits Enough To Represent The Length Of The Run?
406
N
Y
Encode Next Non-Zero Coefficient
408

FIG. 11

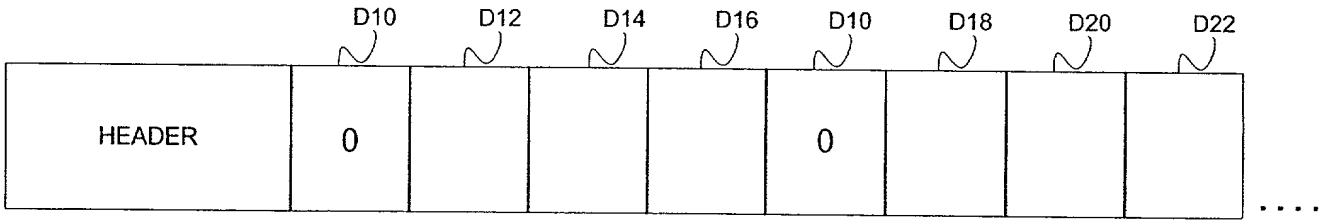


FIG. 12A

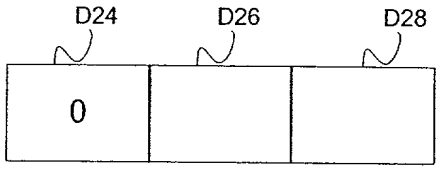


FIG. 12B

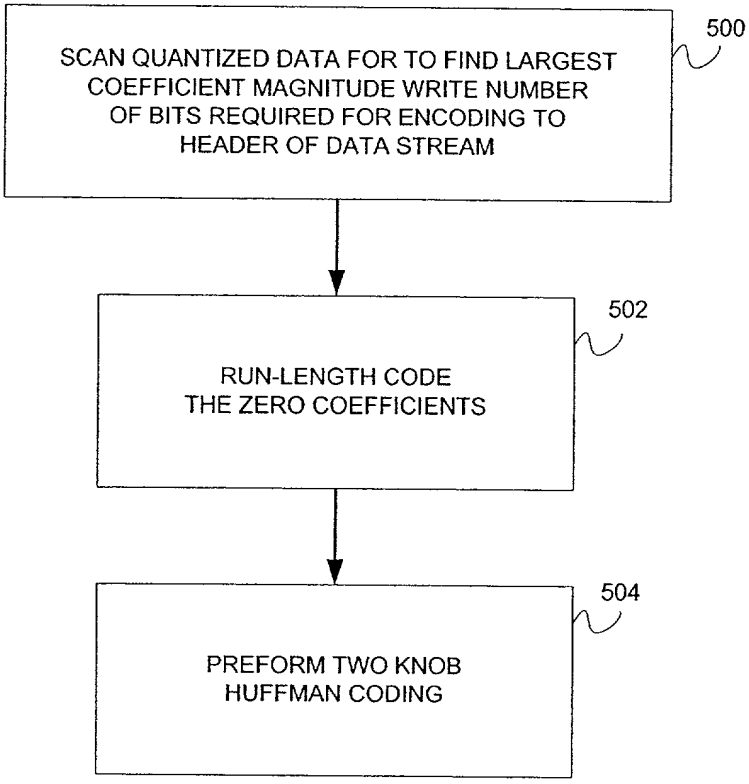

SCAN QUANTIZED DATA FOR TO FIND LARGEST COEFFICIENT MAGNITUDE WRITE NUMBER OF BITS REQUIRED FOR ENCODING TO HEADER OF DATA STREAM
500
RUN-LENGTH CODE THE ZERO COEFFICIENTS
502
PREFORM TWO KNOB HUFFMAN CODING
504

FIG. 13

Value	Code Word
0 short	00
0 long	01
-1	100
1	101
-2	1100
2	1101
-3	11100
3	11101
-4	111100
4	111101
-5	1111100
5	1111101
-6	1111110
escape	1111111

FIG. 14

DC1	$AC_1$1	$AC_1$2	$AC_1$3	$AC_1$4	...	$AC_1$10
DC2	$AC_2$1	$AC_2$2	$AC_2$3	$AC_2$4	...	$AC_2$10
DC3	$AC_3$1	$AC_3$2	$AC_3$3	$AC_3$4	...	$AC_3$10
DC4	$AC_4$1	$AC_4$2	$AC_4$3	$AC_4$4	...	$AC_4$10
DC5	$AC_5$1	$AC_5$2	$AC_5$3	$AC_5$4	...	$AC_5$10
DC6	$AC_6$1	$AC_6$2	$AC_6$3	$AC_6$4	...	$AC_6$10
DC7	$AC_7$1	$AC_7$2	$AC_7$3	$AC_7$4	...	$AC_7$10
DC8	$AC_8$1	$AC_8$2	$AC_8$3	$AC_8$4	...	$AC_8$10
DC9	$AC_9$1	$AC_9$2	$AC_9$3	$AC_9$4	...	$AC_9$10

FIG. 15

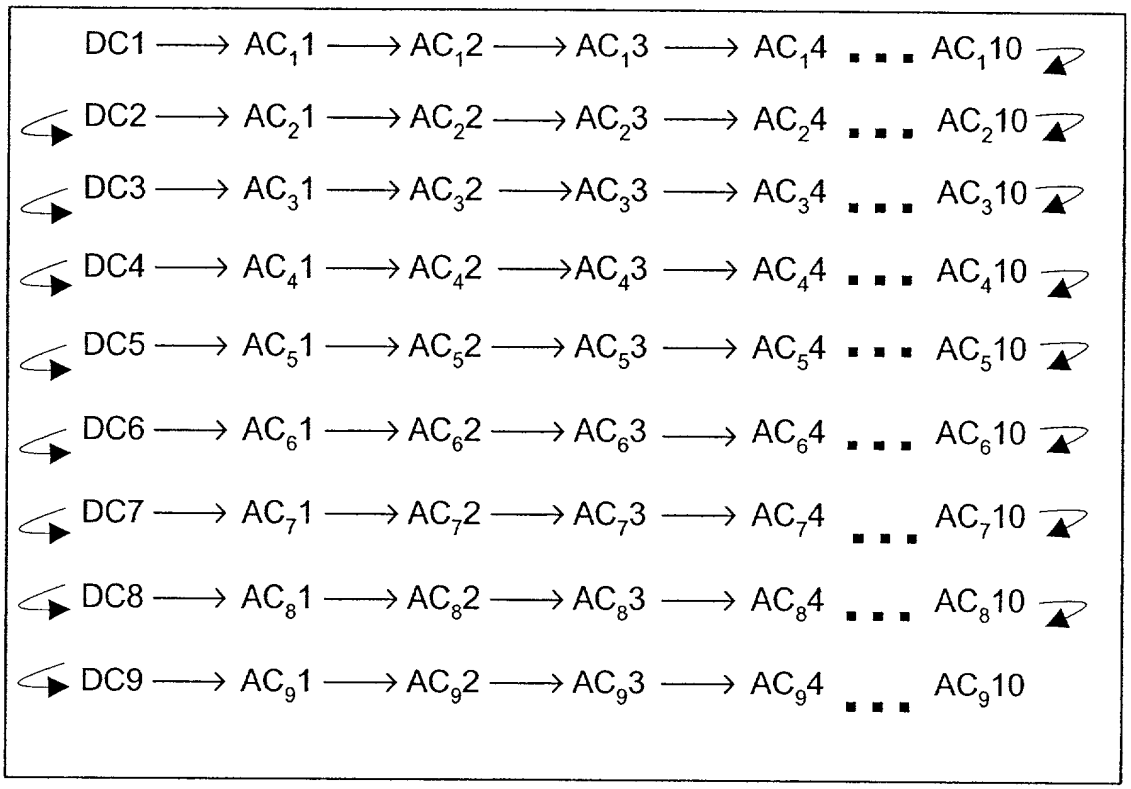

DC1 → AC1 1 → AC1 2 → AC1 3 → AC1 4 . . . AC1 10
DC2 → AC2 1 → AC2 2 → AC2 3 → AC2 4 . . . AC2 10
DC3 → AC3 1 → AC3 2 → AC3 3 → AC3 4 . . . AC3 10
DC4 → AC4 1 → AC4 2 → AC4 3 → AC4 4 . . . AC4 10
DC5 → AC5 1 → AC5 2 → AC5 3 → AC5 4 . . . AC5 10
DC6 → AC6 1 → AC6 2 → AC6 3 → AC6 4 . . . AC6 10
DC7 → AC7 1 → AC7 2 → AC7 3 → AC7 4 . . . AC7 10
DC8 → AC8 1 → AC8 2 → AC8 3 → AC8 4 . . . AC8 10
DC9 → AC9 1 → AC9 2 → AC9 3 → AC9 4 . . . AC9 10

FIG. 16

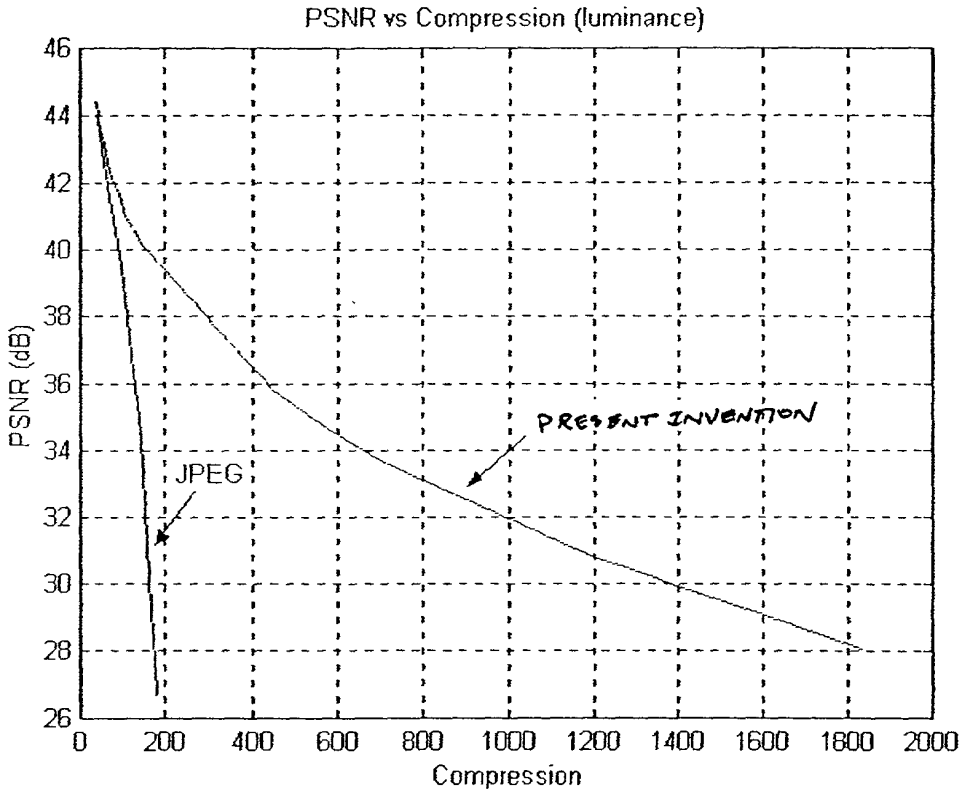
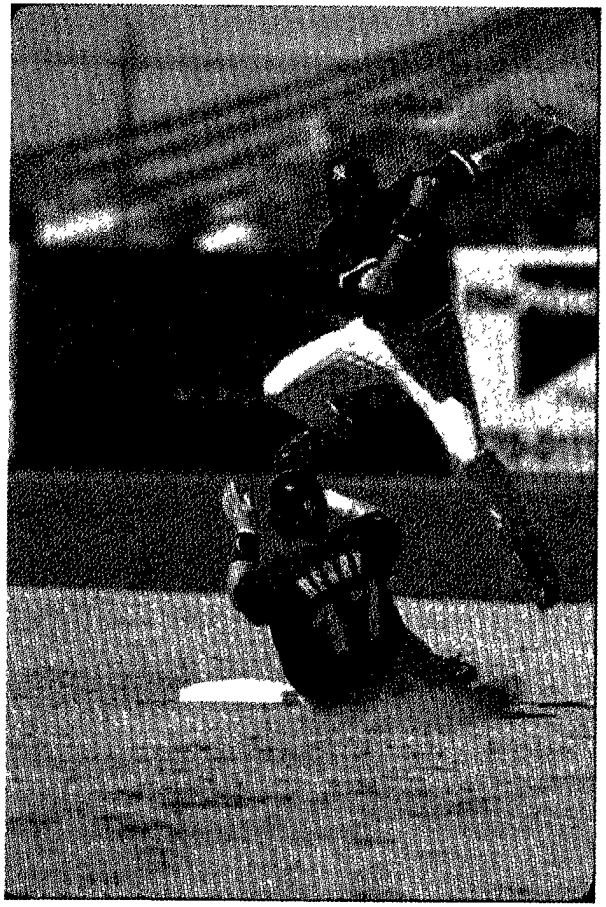
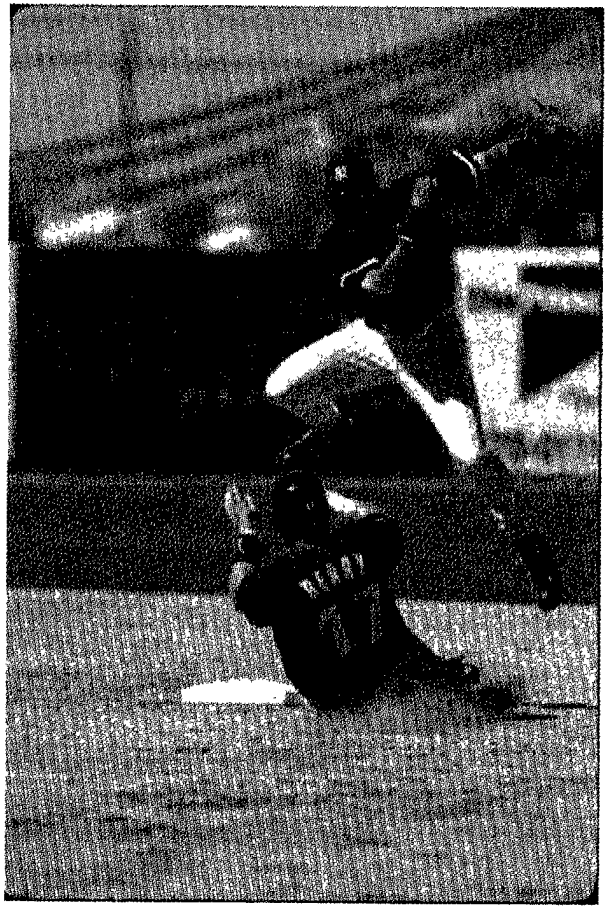

PSNR vs Compression (luminance)
PSNR (dB)
Compression
46
44
42
40
38
36
34
32
30
28
26
0
200
400
600
800
1000
1200
1400
1600
1800
2000
JPEG
PRESENT INVENTION

FIG 17



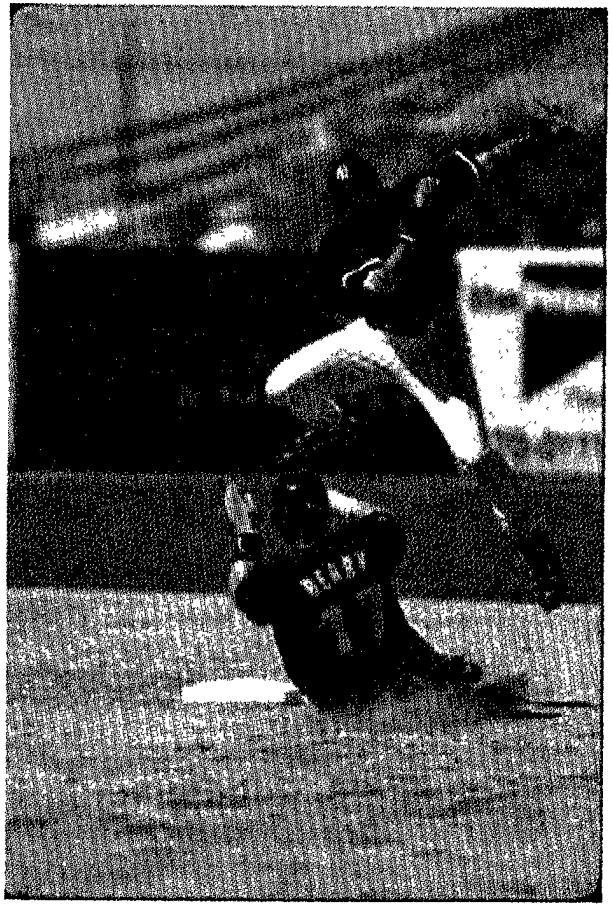
Original

FIG. 18A



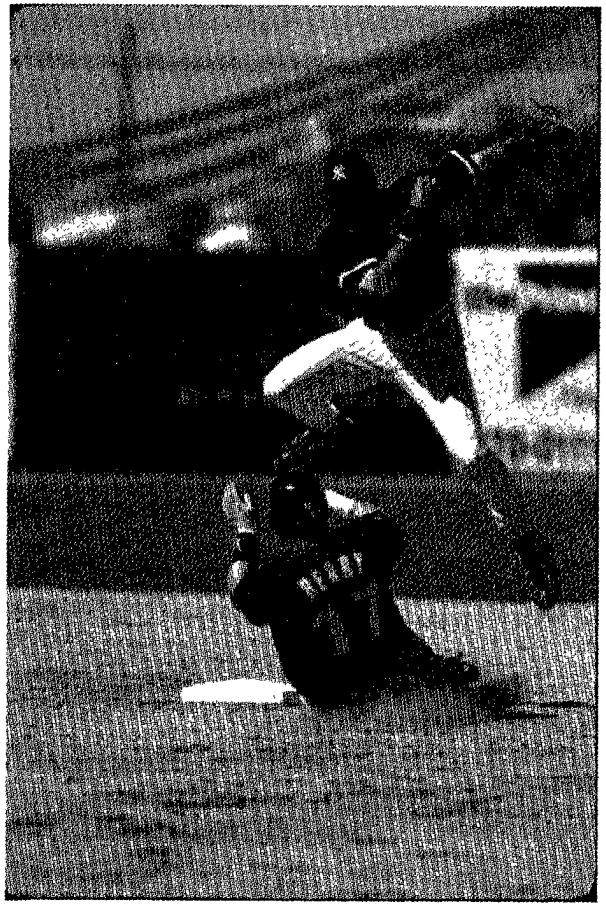
JPEG 77:1

FIG. 18B



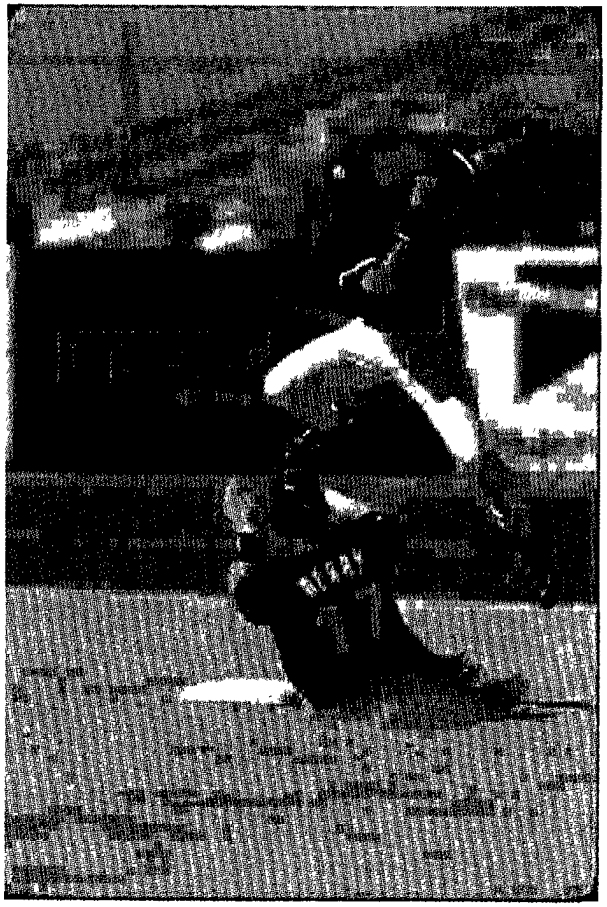
162:1

FIG. 18C



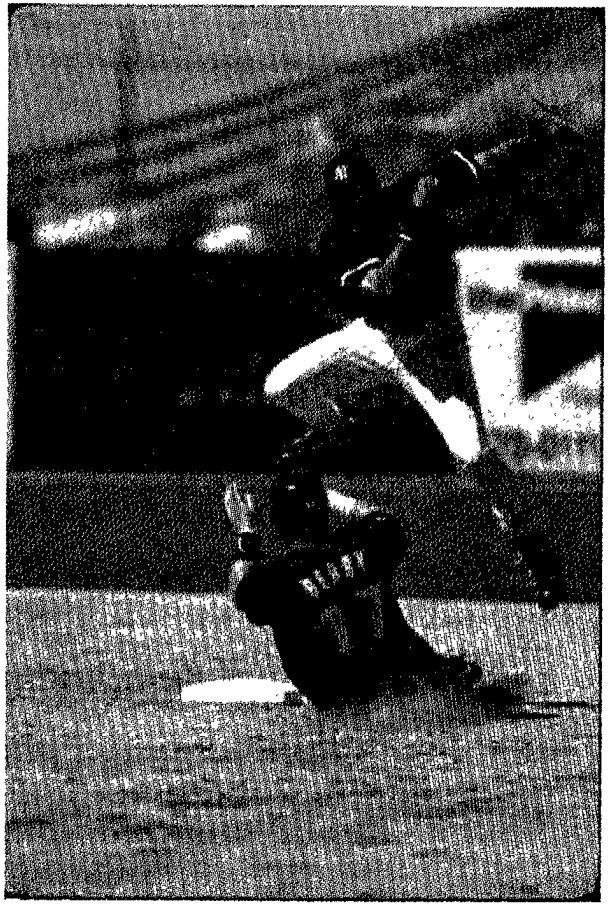
Original

FIG. 19A



JPEG 163:1

FIG. 19B



162:1

FIG. 19C